FEMP/PFGE

FEDERAL ENERGY MANAGEMENT PROGRAMS / PROGRAMMES FÉDÉRAUX DE GESTION DE L'ÉNERGIE

Internal Energy Conservation Program

Federal Internal Retrofit Program

Federal Internal Off-Oil Program

Federal Propane Vehicle Program

Programme interne d'économies d'énergie

Programme interne de réfection

Programme interne de remplacement du pétrole

Programme fédéral de subvention pour les véhicules au propane

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Canada

Briefing Document
on
Development of Technical Training Courses for Federal Government of Canada Building Operating Technical Personnel

Contracting Authority
Supply and Services Canada
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TRAINING COURSE SUBJECT INDEX

SUBJECT	TITLES
1.	Reasons for Energy Management
2.	Air Quality and Energy Management
3.	Economic Evaluations
4.	Utility Cost Structure
5.	Energy Awareness
6.	Lighting
7.	Electrical Systems
8.	Controls
9.	Energy Management Systems (Centralized Controls)
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11.	Heating Systems
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18.	Pumps and Pumping
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25. Waste Heat Recovery

26. Special Systems

27. Diesel Generators

28. Steam Turbines

29. Vertical Transportation

TRAINING COURSE SUBJECT INDEX

SUBJECT	TITLE AND SHORT DESCRIPTION
1.	Reasons for Energy Management - the supply and demand of energy with its significance to the Canadian Government relative to energy management past, present and future.
2.	Air Quality and Energy Management - the analysis of building environment and the effects of energy management upon that environment.
3.	Economic Evaluations - the techniques used to evaluate the economic viability of energy management retrofit concepts.
4.	Utility Cost Structure - an understanding of the information on utility bills.
5.	Energy Awareness - methods of organizing energy consumption data to make it useful as an energy management tool.
6.	Lighting - review of the role the building personnel can play and actions they can take to save energy and maintain good tenant relationships in their buildings.
7.	Electrical Systems - the various uses of electricity and how this use can be evaluated for energy management - consumption and demand meters, motor types, power factor considerations - other relevant topics.

SUBJECT	TITLE AND SHORT DESCRIPTION
8.	Controls - controls as they are now and how they could be - Direct Digital Control versus Proportional Integral Directive Control and such day to day problems as water in pneumatic lines.
9.	Energy Management Systems (Centralized Controls) - energy management systems with reference to the application of computer hardware and software to modern building systems.
10.	Control of Rate of Electrical Consumption (Demand) - the economic impact of demand specific to the workshop attendees's areas and analyzing methods.
11.	Heating Systems - energy management strategies applicable to hot water and steam heating systems where the boilers are not located in a large central plant - typical problems - boiler controls.
12.	Oil Burners - theory and practice of operating residential type oil burners - operational considerations a person must understand to operate a residential oil fired furnace or boiler.
13.	Steam Plants - this is not a course to teach Stationary Engineers their business but to review generally accepted energy management strategies that apply to steam plant operation.
14.	Hot Water Boilers - boilers in hot water systems - operation for energy management - burner controls, etc.

SUBJECT	TITLE & SHORT DESCRIPTION

15. Humidification

- reasons for humidification
- types of humidifiers and their efficient operation.

16. Cooling Systems (Large Central Systems)

- energy management strategies for chillers, cooling towers, direct expansion cooling equipment, coils and the control equipment in large plants.

17. Cooling Systems (Not Large Central Systems)

- operation, maintenance and controls for all other types of cooling systems not considered in subject 16, i.e., packaged equipment, roof top and incremental through the wall packages, small built-up reciprocating systems, etc.

18. Pumps and Pumping

- fundamental pumping principles
- pump curves
- pump types and characteristics
- pump and system interaction
- energy management strategies.

19. Water Treatment

- proper water treatment and the effects of improper water treatment
- operational suggestions for water treatment optimization.

20. Fans

- fan types
- typical characteristics and uses in building air systems
- capacity control devices
- relevant fan laws
- operating procedures for energy management.

SUBJECT	TITLE & SHORT DESCRIPTION

21. Air Systems

- design theory and strategies for energy management for the significant air handling systems
- dampers
- diffusers
- economics of ventilation.

22. Instrumentation

- type, number and location to facilitate an understanding of the operation of building systems and energy consumption.

23. Air Filtration

- air filtration theory
- filtration types and specific uses
- maintenance for energy management.

24. Building Envelope

- glazing changes
- caulking
- increased R values
- economic analysis methods.

25. Waste Heat Recovery

- heat reclaim equipment
- explanation of different operational choices
- limitations
- economic opportunities for energy management.

26. Special Systems

- energy management strategies for:
  - kitchens
  - laundries
  - swimming pools
  - domestic hot water
  - snow melting
  - automboile block heaters
  - garages, etc.

SUBJECT	TITLE & SHORT DESCRIPTION
27.	Diesel Generators - heat reclaim from flue gasses and engine coolant.
28.	Steam Turbines - operating methods for improved efficiency - drivers using waste energy.
29.	Vertical Transportation - energy management strategies for elevators and escalators.

DIRECTIVES TO COURSE WRITERS

1. The objective of this program is to explain the energy management implications of system operation to building operating personnel in order that federal buildings may consume less energy.

2. It must be appreciated that the attendees, with the exception of management, will be generally technically oriented persons varying in experience from apprenticeship to retirement.

   It should be assumed that the minimum formal educational level will be Grade 10 technical and the course must be written in terms understandable to the attendees.

3. Courses shall be in a modular format. For each subject there will be up to three modules.

   (a) INTRODUCTION - oriented toward management to give an overview of the modular subject.

   (b) LEVEL I - oriented toward the technical personnel who are associated with the equipment or subject BUT NOT RESPONSIBLE FOR IT.

   For example: a plumber or electrician would be a Level I mechanic with H V A C equipment or subject

   an H V A C mechanic would be Level I with water treatment or steam boiler equipment.

   (c) LEVEL II - oriented toward the technical operators WHO ARE RESPONSIBLE FOR THE OPERATION AND MAINTENANCE OF THIS EQUIPMENT OR SUBJECT.

   For example: H V A C mechanics on an Air Systems subject.

4. Each module shall be self-contained and complete with its own slides, graphs, script, examples, etc., and shall have a designated presentation time.

5. The module format shall be such that, in written form, it can be inserted as a unit into a manual. (See attached Appendix I).

   The slides, graphs, etc., shall be printed immediately adjacent to the associated script.

6. When constants are used in calculations they shall be shown in the script or on the slide and explained,

   i.e. - $1.2 \cdot \frac{L}{S} \cdot K = W$

   - 1.2 = specific heat x specific volume, of air.
   - K = temperature differential in degrees Celsius

7. Modular Delivery Philosophy

ATTENDEES	MODULE
Management only	Introduction
Personnel not responsible for this equipment or subject only	Level I
Personnel responsible for operation of this specific equipment or subject only	Level II
Mixture of management and technical personnel	Level II

8. All costing discussions must be site or area specific i.e., utility bills, degree days, etc.

9. The manual given to the attendees shall include all subjets and all modules.

10. On the discussion of upgrading site controls there must be a separate discussion on electric, electronic and pneumatic control systems.

11. All suggestions and directives must be in accordance with the Federal Government guidelines.

SUBJECT 1. REASONS FOR ENERGY MANAGEMENT

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 20 mins.
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Supply/demand outlook - world wide
- Canadian
- provincial

Section 2. Significance of energy in total operating costs for departments and for the entire Federal Government.

Section 3. Attractiveness of investment in energy management. Typical paybacks on ROI.

Section 4. Energy performance to date of the Federal Government.

Section 5. Remaining energy management potential.

Section 6. Attendees personal involvement. What effort is required and what can be achieved.

LEVEL I MODULE

Section 1. Supply/demand outlook - world wide
- Canadian
- provincial

Section 2. Significance of energy in total operating costs for departments and for the entire Federal Government.

Section 3. Attractiveness of investment in energy management. Typical paybacks on ROI.

Section 4. Energy performance to date of the Federal Government.

Section 5. Remaining energy management potential.

Section 6. Attendees personal involvement. What effort is required and what can be achieved.

LEVEL II MODULE

Section 1. Supply/demand outlook - world wide
- Canadian
- provincial

Section 2. Significance of energy in total operating costs for departments and for the entire Federal Government.

Section 3. Attractiveness of investment in energy management. Typical paybacks on ROI.

Section 4. Energy performance to date of the Federal Government.

Section 5. Remaining energy management potential.

Section 6. Attendees personal involvement. What effort is required and what can be achieved.

SUBJECT 2. AIR QUALITY AND ENERGY MANAGEMENT

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 30 mins.
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Energy management and its impact on the environment of the building occupant. State-of-the-art of environmental quality analysis in office buildings.

Section 2. Measurement of air quality.

LEVEL I MODULE

Section 1. Energy management and its impact on the environment of the building occupant. State-of-the-art of environmental quality analysis in office buildings.

Section 2. Measurement of air quality.

Section 3. Sources of pollutants and their effect on humans.

Section 4. Allowable limits on pollutants and by what authority for:

- CO_2
- CO
- radon
- formaldehyde
- others

Section 5. Effect of environmental considerations on building structure.

LEVEL II MODULE

Section 1. State-of-the-art of environmental air quality in buildings. (Energy managment has been accused of adversely effecting the building occupant environment).

Section 2. Air quality measurement procedures.

Section 3. Sources of pollutants and their effect on humans.

Section 4. Allowable limits of pollutants and by what authority for:

- CO^2
- CO
- radon
- formaldehyde
- others

Section 5. Effect of environmental considerations on building structure.

SUBJECT 3. ECONOMIC EVALUATIONS

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 10 mins.
Level II - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Philosophy - since every financial expenditure for energy management has to be justified, the methods of calculating the financial return must be understood by those making the evaluation.

LEVEL I MODULE

Section 1. Explanation of Remaining Useful Life (RUL) and simple payback.

Section 2. The EMR Remaining Useful Life (RUL) rule.

If you take twelve years or the life of the activity, whichever is greater, and subtract the simple payback period and if the resultant Remaining Useful Life (RUL) is seven or greater the project is automatically eligible for funding. (Ref. CR9150-8)

LEVEL II MODULE

Section 1. Explanation of Remaining Useful Life and simple payback.

Section 2. The EMR Remaining Useful Life (RUL) rule.

If you take twelve years or the life of the activity, whichever is greater, and subtract the simple payback period and if the resultant Remaining Useful Life (RUL) is seven or greater the project is automatically eligible for funding. (Ref. CR9150-8)

Section 3. Explanation of the EMR assessment nomograph (attached).

SUBJECT 4. UTILITY COST STRUCTURE

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 25 mins.
Level II - up to 45 mins.

INTRODUCTORY MODULE

Section 1. Information on local electricity and gas bills.

Section 2. Discussion of marginal electricity rates, (demand and consumption).

Section 3. Discussion re: penalties.

- power factor
- minimum contracts
- demand penalties

Section 4. Special rates.

- big users, time of day, etc.

LEVEL I MODULE

Section 1. Information on bills (electricity and gas).

- discussion on local billing information.

(i) ratchet clauses
(ii) listed demand costs
(iii) additional charges (transformers, etc.)
(iv) penalties (power factor)

Section 2. Calculation of marginal demand rate and compare with value on bill.

Section 3. Discussion of season demand peak considerations specific to attendees' areas.

Section 4. Discussion of:
- minimum gas contracts
- gas demand conditions specific to attendees' sites
- interruptable gas and electricity (heating) contracts

LEVEL II MODULE

Section 1. Information on bills (electricity and gas).

- discussion on local billing information.

  (i) ratchet clauses
  (ii) listed demand costs
  (iii) additional charges (transformers, etc.)
  (iv) penalties (power factor)

Section 2. Calculation of marginal demand rate and compare with value on bill.

Section 3. Discussion of season demand peak considerations specific to attendees' areas.

Section 4. Discussion of:

- minimum gas contracts
- gas demand conditions specific to attendees' sites
- interruptable gas and electricity (heating) contracts

SUBJECT 5. ENERGY AWARENESS

DELIVERY TIMES

Introduction - up to 5 mins.
Level I - up to 1 hour
Level II - up to 2 hours

INTRODUCTORY MODULE

Section 1. General philosophy. Awareness of the energy consumption in a building or site, from utility bills and additional metering.

Section 2. Comparison of energy consumption with other similar buildings or from a site energy target.

LEVEL I MODULE

Section 1. General philosophy. Awareness of the energy consumption in a building or site, from utility bills and additional metering.

Section 2. Methods to present energy consumption and cost data (graphical and tabular) for assessement

- meters
  - (i) how to read them
  - (ii) how they work
- oil tank dipsticking
- delivery bills

Section 3. Different meter readings required.

- electrical consumption - kWh
- electrical demand - kW
- electrical demand - kVA
- water - litres, gallons
- gas - m^3, mcf, ccf
- oil - litres

Section 4. Plotting methods for each energy source.

- energy consumption versus time
- energy consumption versus degree days
- electrical rate of consumption (demand) versus time

Section 5. Analysis of energy consumption with above plotting methods.

Section 6. Normalization manually or with a computer program in order to assess the energy consumption in a building. Normalization could include area, weather, occupancy etc.

Section 7. Comparison of energy consumption with other similar buildings or from a site energy target.

LEVEL II MODULE

Section 1. General philosophy. Awareness of the energy consumption in a building or site, from utility bills and additional metering.

Section 2. Methods of obtaining energy quantities.

- meters
  - (i) how to read them
  - (ii) how they work
- oil tank dipsticking
- delivery bills

Section 3. Different meter readings required

- electrical consumption	- kWh
- electrical demand	- kW
- electrical demand	- kVA
- water	- litres, gallons
- gas	- m^3, mcf, ccf
- oil	- litres

Section 4. Plotting methods.

- energy consumption versus time
- energy consumption versus degree days
- electrical rate of consumption (demand) versus time

Section 5. Understanding of:

- how to read the meter
- how to plot the metered energy on the relevant graphical formats
- the meaning of these graphical formats
- weather normalizing
- the site specific financial implications of the energy patterns plotted.

Section 6. Comparison of energy consumption with similar buildings or from a site target.

SUBJECT 6. LIGHTING

DELIVERY TIMES

Introduction - up to 15 mins.
Level I - up to 30 mins.
Level II - up to 2 hours

INTRODUCTORY MODULES

Section 1. Importance of lighting to tenants. The role of building personnel with respect to tenant complaints and maintenance.

Typical complaints and corrective measures.

Section 2. Impact of lighting system on other energy consuming systems (e.g., cooling, heating etc.)

Section 3. Recommended and mandatory lighting levels.

Section 4. Relative importance of lighting in total energy use.

LEVEL I MODULE

Section 1. Importance of lighting to tenants. The role of building personnel with respect to tenant complaints and maintenance.

Typical complaints and corrective measures.

Section 2. Discussion on the different lighting uses

- general work
- task
- decorative
- emergency
- quiet hours

Section 3. Impact of lighting system on other energy consuming systems (e.g., cooling, heating etc.)

Section 4. Recommended and mandatory lighting levels.

Section 5. Relative importance of lighting in total energy use.

Section 6. Overview of specific lighting energy management measures

e.g., - delamping, deballasting
- lamp types, efficiencies, colour rendering and applications
- low voltage and incandescent lamp life
- dummy tubes

LEVEL II MODULE

Section 1. Importance of lighting to tenants. The role of building personnel with respect to tenant complaints and maintenance.

Typical complaints and corrective measures.

Section 2. Discussion on the different lighting uses

- general work
- task
- decorative
- emergency
- quiet hours

Section 3. Impact of lighting system on other energy consuming systems (e.g., cooling, heating etc.)

Section 4. Recommended and mandatory lighting levels.

Section 5. Relative importance of lighting in total energy use.

Section 6. Overview of specific lighting energy management measures

e.g., - delamping, deballasting
- lamp types, efficiencies, colour rendering and applications
- low voltage and incandescent lamp life
- dummy tubes

Section 7. Light meters as a measurement tool (e.g., - accuracy and reliability).

Section 8. Explanation of "Glare", sources, impact on occupants and its control.

Section 9. Health effects of light. Myths and facts.

Section 10. Matching lamps and ballasts, efficiency and fixture efficiency, effect of temperature and voltage.

Section 11. Meaning of manufacturer's definition of lamp "life".

Section 12. Switching and Dimming.

- manual
- automatic
- photoelectric
- what is the limiting off time below which the depreciation of tube life exceeds the savings in energy. An explanation with listed assumptions
- occupancy detectors.

Section 13. Day lighting and opportunities to turn off lights.

SUBJECT 7. ELECTRICAL SYSTEMS

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 30 mins.
Level II - up to 2 hours.

INTRODUCTORY MODULE

Section 1. Electrical energy use as a percentage of total electricity consumption

Lights	( )
Fans	( )
Air Conditioning	( )
Elevators	( )
Office Equipment	( )
Heating	( )
Processes	( )

Section 2. The relationship between air and water flow and electrical energy consumption.

Section 3. Methods of analysis of electrical consumption.

- general methods of consumption and demand analysis.
- economic considerations of electrical energy consumption and demand energy management strategies (to include site utility costing structures).

LEVEL I MODULE

Section 1. The relationship between air and water flow and electrical energy consumption.

Section 2. Explanation of methods to calculate and record electrical energy consumption and demand.

- explain units (W, J)
- use of graph plots

Section 3. Electrical meters - kWh, kW demand, kVA.

- description
- theory of operation

Section 4. Motor starting and demand considerations.

- requirements for time delay

Section 5. Electrical schematics.

- symbols and their meaning
- a simple schematic diagram explanation

Section 6. Motor efficiency at various loads.

Section 7. Hi-efficiency motors.

- performance and economics relative to standard motors
- consideration of special type motors

LEVEL II MODULE

Section 1. The relationship between air and water flow and electrical energy consumption.

Section 2. Explanation of methods to calculate and record electrical energy consumption and demand.

- explain units (W, J)
- use of graph plots

Section 3. Electrical meters - kWh, kW demand, kVA.

- description
- theory of operation

Section 4. Motor starting and demand considerations.

- requirements for time delay

Section 5. Motor efficiency at various loads.

Section 6. High efficiency motors.

- performance and economics relative to standard motors
- consideration of special type motors

Section 7. Understanding load balance.

Section 8. Discussion of nature of loads.

- inductive
- resistive
- capacitative

Section 9. Power Factor.

Section 10. Motor control circuits with schematic diagram -

- explanation of symbols

(i) normally open relays
(ii) normally closed relays
(iii) holding relays and coils
(iv) etc.

Section 11. Operation and maintenance for energy management.

Section 12. General energy management strategies.

SUBJECT 8. CONTROLS

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 30 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. The importance of controls

Section 2. Types of controls

- operational
- safety
- limit

Section 3. Types of operational controls

- automatic
- manual

Section 4. Discusion on upgrading site controls

- as they are
- as they could be
- as they should be

LEVEL I MODULE

Section 1. The importance of controls

Section 2. Types of controls

- operational
- safety
- limit

Section 3. Types of operational controls

- automatic
- manual

Section 4. Discussion on upgrading site controls

- as they are
- as they could be
- as they should be

Section 5. Location of censors.

Section 6. Insulation of "strap-on" controls.

LEVEL II MODULE

Section 1. The importance of controls

Section 2. Types of controls

- operational
- safety
- limit

Section 3. Types of operational controls

- automatic
- manual

Section 4. Discussion on upgrading site controls

- as they are
- as they could be
- as they should be

Section 5. Location of censors.

Section 6. Insulation of "strap-on" controls.

- as they are
- as they could be
- as they should be

Section 7. Control theory

- P.I.D. (Proportional Integral Derivitative) - explanation, e.g. expectations
- room thermostat - 1°C. throttling range - good control
- duct thermostat - 5°C. throttling range - poor control

- humidistat
- averaging bulb
- difference in elevation of censors on liquid filled systems

Section 8. D D C

- implications
- costs
- effects on energy management
- benefits

Section 9. Moisture in pneumatic control lines.

- Why it occurs. How to eliminate? Should the source of control air be building air or outside air.

Section 10. Air Compressors.

- What pressure at compressor high or low

Section 11. Compressor Operation for Energy Management.

SUBJECT 9. ENERGY MANAGEMENT SYSTEMS (Centralized Controls)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 10 mins.
Level II - up to 2½ hours

INTRODUCTORY MODULE

Section 1. Overview of Energy Management Systems with the effect on system operation and basis of an energy data base.

LEVEL I MODULE

Section 1. Overview of Energy Management Systems with the effect on system operation.

LEVEL II MODULE

Section 1. Description of an Energy Management System. Hardware and Software.

Section 2. Energy management capabilities.

Section 3. Training and troubleshooting.

SUBJECT 10. CONTROL OF RATE OF CONSUMPTION (Demand)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 15 mins.
Level II - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Economic impacts of demand control in different areas across Canada.

LEVEL I MODULE

Section 1. Economic impacts of demand control in different areas across Canada.

Section 2. Demand profile of each analytical period and its evaluation.

LEVEL II MODULE

Section 1. Economic impacts of demand control in different areas across Canada.

Section 2. Demand profile of each analytical period and its evaluation.

Section 3. Potential peak contributors.

Section 4. Energy management strategies to lower or eliminate the demand peaks.

SUBJECT 11. HEATING SYSTEMS

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 20 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. The importance of maintaining water temperatures and steam pressures as low as possible.

Section 2. Night set back. When is it effective and when is it not.

Section 3. Intermediate season plant shut off.

LEVEL I MODULE

Section 1. The importance of maintaining water temperatures and steam pressures as low as possible.

Section 2. Typical design and installation errors in steam and hot water systems which can be detected by site observation.

a. Steam Systems Problems:

- incorrect valve types
- improperly sloped piping
- poor trapping
- water hammer
- flash steam
- pump cavitating

b. Hot Water Systems Problems:

- air pockets and air venting
- improper flow balancing
- incorrect valve types
- uninsulated air vents

Section 3. Night set back. When is it effective and when is it not effective.

Section 4. Coils. The value of keeping them clean.

Section 5. Strategies for energy management.

Section 6. Intermediate season plant shut off.

Section 7. "Practical" freeze-up protection ideas.

LEVEL II MODULE

Section 1. Typical design and installation errors in steam and hot water heating systems which can be detected by site observation.

a. Steam Systems Problems:

- incorrect valve types
- improperly sloped piping
- poor trapping
- water hammer
- flash steam
- pump cavitating

b. Hot Water Systems Problems:

- air pockets and air venting
- improper flow balancing
- incorrect valve types
- uninsulated air vents

Section 2. Environmental Controls for Steam and Hot Water Systems.

- Discussion of advantages, disadvantages and energy management strategies.

  - room (i) 2 position
    (ii) modulating
    (iii) self-contained (Danfoss type)

  - zone (i) 2 position
    (ii) modulating
    (iii) indoor/outdoor reset

  - central (i) indoor/outdoor reset
    (ii) 3 way valve modulating (diverting and mixing)

Section 3. Coils, Fin Tube Radiation, Radiant Heaters

- how dirty equipment effects total energy use.

Section 4. Intermediate season plant shut off.

Section 5. "Practical" freeze-up protection ideas.

Section 6. Strategies for energy management.

SUBJECT 12. OIL BURNERS (Residential Type - Less Than 3.0 Gal./Hr.)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 20 mins.
Level II - up to 3 hours

INTRODUCTORY MODULE

Section 1. The theory and practice of operating residential type oil burners. The intent is to have a course for personnel stationed in isolated areas and supervisors of small residential furnace operations to give them a feeling for what oil burner and furnace operation and maintenance is all about, with specific reference to energy management.

LEVEL I MODULE

Section 1. Black smoke.

Section 2. Hot flue.

Section 3. Soot in burner area.

LEVEL II MODULE

Section 1. Theory.

Section 2. Standard controls.

Section 3. General operation and maintenance.

Section 4. Stack height and down drafts.

Section 5. Schematic control diagram understanding.

Section 6. Energy management strategies.

Section 7. Codes and standards.

SUBJECT 13. STEAM PLANTS

DELIVERY TIMES
Introduction - up to 5 mins.
Level II - up to 2 hours

INTRODUCTORY MODULE

Section 1. It is not the intention to attempt to teach Certified Stationary Engineers their profession. There are, however, some practices that could be reevaluated for energy management.

The scope of this subject should include all steam plant equipment in current use by the Federal Government.

LEVEL II MODULE

Section 1. Steam pressures - discussion on

- major concerns
- changes (lowering)
- considerations of changes
- processes
- lift traps
- turbines
- others

Section 2. Determination and evaluation of boiler plant standing losses.

Section 3. Determination and evaluation of transmission losses. Energy management changes.

Section 4. Strategies for energy management.

- Reduce fireside and waterside deposits
- Flue gas economizers
  (i) discussions on how or how not to use
- Burner controls
  (i) optimization for seasonal efficiency

- Steam traps
  - (i) specific traps, their purpose and their troubles
- Thermal insulation of equipment
  - (i) valves, expansion joints
  - (ii) economics - what temperature
    - what insulation is viable
- Control of excess air
- Optimize multiple boiler efficiency.

Section 5. Boiler make up water considersations.

- percent make up
- what is excessive
- costs of make up
  - (i) heating
  - (ii) treatment
  - (iii) water cost

Section 6. High level combustion air intakes.

Section 7. Adequate boiler controls and metering.

Section 8. Steam pressure reduction effect on various types of boilers (e.g. fire tube and large refractory boilers).

Section 9. Boiler pressure derating considerations.

SUBJECT 14. HOT WATER BOILERS

DELIVERY TIMES
Introduction - up to 5 mins
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Overview of water temperature requirements and burner controls and their impact on energy management.

LEVEL II MODULE

Section 1. Operation of energy management.

- minimum water temperature
- accurate, reliable water temperature controls
- outdoor reset
- indoor reset
- location of expansion tank

Section 2. Burners

- theory of operation - gas burners
- theory of operation - oil burners
- controls
  - (i) single stage
  - (ii) 2 stage
  - (iii) modulating
  - (iv) theory and how to understand settings
- energy management strategies

Section 3. Automatic flue gas dampers

- discussion re energy savings

Section 4. Discussion on relative position of feed water and pump in conjunction with boiler pressure and N.P.S.H.

Section 5. Pressure gauge to measure pump pressure and strainer pressure drop.

Section 6. Strainers - cleaning properly

SUBJECT 15. HUMIDIFICATION

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 20 mins.
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Reasons for humidification.

- health
- special equipment requirements

Section 2. Operation for energy management. Humidification in heating season is not free. To evaporate 1 kg. of water = 480 kJ.

Section 3. Relationship between ventilation and quantity of humidification required.

LEVEL I MODULE

Section 1. Reasons for humidification.

- health
- special equipment requirements

Section 2. Types of humidifiers with advantages and disadvantages of each.

- steam injection
- water spray
- pan type

Section 3. Maintenance for health protection.

- Respiratory type diseases
- steam boiler water treatment

Section 4. Operation for energy management.

LEVEL II MODULE

Section 1. Reasons for humidification.

- health
- special equipment requirements
- free cooling

Section 2. Types of humidifiers with advantages and disadvantages of each.

- steam injection
- water spray
- pan type
- swamp coolers

Section 3. Psychometric chart explanation.

Section 4. Maintenance for equipment protection.

Section 5. Maintenance for health protection.

- Respiratory type diseases
- steam boiler water treatment

Section 6. Operation for energy management.

SUBJECT 16. COOLING SYSTEMS (Large Central Systems)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 30 mins.
Level II - up to 2 hours

INTRODUCTORY MODULE

Section 1. Fundamentals for energy management.

- refrigerant lift control
- turn it off as often as possible
- morning start up
- understanding the story the gauges tell
- suction temperatures and humidity

LEVEL I MODULE

Section 1. Chiller Operation

a. An understanding of what to look for and the meaning of what is seen.

- setting of demand controller
- motor amperage
- entering chilled water temperature
- leaving chilled water temperature
- condenser water temperatures entering and leaving
- condensing temperature and pressure
- unusual noises - surging
- suction temperature too low

Section 2. Direct Expansion. An understanding of what is seen and heard at a compressor.

- short cycling
- variations in loading
- frosting of suction covers
- frosted cooling coils

Section 3. Cooling Towers. The effects of air recirculating.

- effect of oil vapours in cooling tower air

LEVEL II MODULE

Section 1. Chiller types and their fundamental principles and advantages and disadvantages:

- centrifugal
- reciprocating
- screw
- absorption
- free cooling centrifugal

Section 2. Chiller operation for energy management.

a. Chiller loading

- how to operate for maximum efficiency and demand control

b. Chilled and condenser water temperature control for maximum efficiency.

- percent savings due to raising chilled water temperatures (dehumidification considerations)
- percent savings due to lowering condenser water temperatures

c. Explanation of controls

- chilled water temperature controller - its operation and location
- demand controller

d. Surging

- explanation (Graph-Head versus Capacity)
- control (Graphical)

e. Gauges

- proper location (static head effect)

Section 3. Direct Expansion Cooling

- fundamental principles
- overview of trouble diagnosis
- control - what to do and what not to do
- energy management strategies

Section 4. Evaporative Cooling (Swamp coolers)

- fundamental principles using psychometric chart analysis
- potential problems
- maintenance for equipment
- maintenance for health
- control
- liming considerations
- energy management strategies

Section 5. Cooling Coils

- advantages and disadvantages of each type (e.g., carry over and what to do about it)
- potential problems (e.g., accumulation of dirt, liming if sprayed)
- energy management control considerations

Section 6. Control Equipment and Energy Management Strategies

- chilled water temperature control
- condenser water temperature control
- control schematics understanding
- operating controls - what they do and how
- trouble shooting
- safety controls

Section 7. Maintenance for Good Energy Management

a. Tube cleaning

- how do you know if cleaning is required

b. Purge unit

- when is purging required
- should it be manual or automatic

c. Air leaks

- how to detect
- how much is too much

d. Freon in oil

- how do you know
- how serious

Section 8. Cooling Towers

- types with advantages and disadvantages
- theory of operation
- make up water requirements
- air recirculation
- use for chilled water cooling

Section 9. Free Cooling Chillers

- fundamental theory
- controls
- operating conditions

Section 10. Refrigerant temperature and pressure relationships.

SUBJECT 17. COOLING SYSTEMS (Not Large Central Systems)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 20 mins.
Level II - up to 2 hours

INTRODUCTORY MODULE

Section 1. Types
- central plant
- rooftop packages
- rooftop splits
- incremental (through-the-wall)
- in area packages

Section 2. Operation of each type for energy management.

LEVEL I MODULE

Section 1. Types
- small central plant direct expansion
- rooftop packages
- rooftop splits
- incremental (through-the-wall)
- in area packages

Section 2. Equipment inspection and interpretation of observations.

Section 3. Operation for energy management.

LEVEL II MODULE

Section 1. Discussion of fundamental refrigeration theory with references to specific equipment types.

Section 2. Types - theory of operation and control.

- small central station direct expansion
- rooftop packages
- rooftop splits
- incremental (through-the-wall)
- in area packages

Section 3. Condensers - theory of operation and control.

- air cooled
- water cooled
- evaporative

Section 4. Cooling Coils

- equipment observation for energy management

  (i) carry over
  (ii) high air side pressure drop

Section 5. Refrigerants

- discussion on the effects of incorrect refrigerant type in equipment and how to recognize it.
- temperature and pressure relationships

Section 6. Evaporative Cooling (Swamp Coolers)

- theory of operation
- applications

Section 7. Strategies for energy management operation of cooling systems (which are not central plant).

SUBJECT 18. PUMPS AND PUMPING

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 10 mins.
Level II - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Discussion on the impact of pumping on energy management.

- percent of total operating costs
- opportunities for energy management.

LEVEL I MODULE

Section 1. Pump types

- centrifugal
- piston or positive displacement
- gear
- sump
- jet

Section 2. Energy management opportunities.

LEVEL II MODULE

Section 1. Pump types, fundamental theory and specific applications.

- centrifugal
- piston or positive displacement
- gear
- sump
- jet

Section 2. Relevant pumping laws.

Section 3. Pump curves.

Section 4. With reference to energy management, discussion on

- N.P.S.H.
- seals
- maintenance

SUBJECT 19. WATER TREATMENT

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 10 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. A brief explanation on how proper water treatment saves energy. (Oxidization, acidity, plugging of pipes)

LEVEL I MODULE

Section 1. A brief explanation on how proper water treatment saves energy.

LEVEL II MODULE

Section 1. Water treatment theory as relevant to -

(i) protection of life and property
(ii) extension of equipment life
(iii) operating expense reduction
(iv) operating heating pumps in summer to prevent corrosion
(v) di-electric corrosion - the effect of the size of the area of copper and steel piping which is common to heating and cooling systems.
(vi) types of corrosion - oxygen, acidity
(vii) chemical solubility of compounds

SUBJECT 20. FANS

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 20 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. The importance of fan operation on energy management in relation to outside air, heating, cooling and fanning.

Section 2. Fanning energy as a percentage of total operating electrical costs.

LEVEL I MODULE

Section 1. The importance of fan operation on energy management in relation to outside air, heating, cooling and fanning.

Section 2. Types - characteristics and typical uses.

- forward curved centrifugal
- backward inclined centrifugal
- airfoil bladed centrifugal
- radial bladed centrifugal
- propellers
- vane axial
- tube axial
- roof ventilators
- turbine type (small)
- mixed flow

LEVEL II MODULE

Section 1. The importance of fan operation on energy management in relation to outside air, heating, cooling and fanning.

Section 2. Types - characteristics, typical uses, fan curves and problems (surging, motor overload, system curve interaction etc.)

- forward curved centrifugal
- backward inclined centrifugal

- airfoil bladed centrifugal
- radial bladed centrifugal
- propellers
- vane axial
- tube axial
- roof ventilators
- turbine type (small)
- mixed flow

Section 3. Relevant fan laws.

Section 4. Capacity control

- variable inlet vanes
- outlet volume dampers
- variable speed
- variable pitch blades
- Markhot Varimark

Section 5. Dirt on fan blades and its effect on energy use.

Section 6. Operating procedures for energy management.

SUBJECT 21. AIR SYSTEMS (Theory, Damper, Diffusers, Economics etc.)

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 1 hour
Level II - up to 4 hours

INTRODUCTORY MODULE

Section 1. Discussion on the economic impact of air systems designed and operated without energy management considerations.

LEVEL I MODULE

Section 1. Potential for energy waste in air systems.

- reheat
- leaking outside air dampers
- exhaust fans operating during non use hours
- others

Section 2. Overview of the design theory of various types of air systems and strategies for energy management.

- constant volume terminal reheat
- variable volume terminal reheat
- double duct
- induction systems
- fan coil units
- unit ventilators
- multizone
- constant volume variable temperature
- variable volume variable temperature
- free air cooling (economizer cycle)
- others

Section 3. Dampers
- types
  - (i) parallel blade
  - (ii) opposed blade
  - (iii) newer types (Mitco)
  - (iv) back draft
  - (v) roll type (garage doors)
- design theory
- problems
  - (i) maintenance
  - (ii) control
  - (iii) leakage
- maintenance for energy management

Section 4. Diffusers

- types
- design theory
- problems
  - (i) throw
  - (ii) dumping
  - (iii) noise
- maintenance for energy management
  - (i) ribbons to indicate air flow

Section 5. Requirements for ventilation

- garages
- human requirements
- others

Section 6. Economics of ventilating air ($/L•s•a)

- codes and standards
- operating hours
- geographic location

LEVEL II MODULE

Section 1. In depth review of the design theory of the various types of air systems and strategies for energy management.

- constant volume terminal reheat
- variable volume terminal reheat
- double duct
- induction systems
- fan coil units
- unit ventilators
- multizone
- constant volume variable temperature
- variable volume variable temperature
- free air cooling (economizer cycle)

Section 2. Dampers -
- types
  - (i) parallel blade
  - (ii) opposed blade
  - (iii) newer types (Mitco)
  - (iv) back draft
  - (v) roll type (garage door)
- design theory
- problems
  - (i) maintenance
  - (ii) control
  - (iii) leakage

- maintenance for energy management
- discussion on the effects of mixing box and damper design on air mixing, stratification and temperature sensing

Section 3. Diffusers

- types
- design theory
- problems
  - (i) throw
  - (ii) dumping
  - (iii) noise
- maintenance for energy management
  - (i) ribbons to indicate air flow

Section 4. Requirements for ventilation

- garages
- human requirements
- others

Section 5. Economics of ventilating air ($/L-s-a)

- codes and standards
- operating hours
- geographic location

SUBJECT 22. INSTRUMENTATION

DELIVERY TIMES
Introduction - up to 2 mins.
Level I - up to 15 mins.
Level - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Type and number of instruments to facilitate the determination of system operation and energy consumption.

e.g., - thermometers
- pressure gauges
- metering equipment
- composite

LEVEL I MODULE

Section 1. Type and numbers of instruments to facilitate the determination of the operation of the system components and its energy consumption.

Section 2. Location of sensing modules of thermometers, pressure gauges, ammeters and meters wherever this information is required and posting of normal readings.

LEVEL II MODULE

Section 1. Type and numbers of instruments to facilitate the determination of the operation of the system components and its energy consumption.

Section 2 Location of sensing modules of thermometers, pressure gauges, ammeters and meters wherever this information is required.

Section 3. The responsibilities of the operator in calibration, establishing "normal" readings for staff, keeping logs, analysis of information, etc.

Section 4. Don't jump to conclusions when something appears wrong.

SUBJECT 23. AIR FILTRATION

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 10 mins.
Level II - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Discussion of energy management advantages of proper filtration.

LEVEL I MODULE

Section 1. Fundamental theory and necessity of air filtration

Section 2. Filtration types and specific uses

Section 3. Maintenance for energy management

Section 4. Codes and standards

LEVEL II MODULE

Section 1. Fundamental theory and necessity of air filtration

Section 2. Filtration types and specific uses

Section 3. Clean and dirty static pressures across the different types of filters

Section 4. Maintenance for good energy management

Section 5. Applicable codes and standards

SUBJECT 24. BUILDING ENVELOPE

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 30 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. . Overview of the effect on the building energy use and potential for energy management opportunities.

- glazing
- insulation
- infiltration

LEVEL I MODULE

Section 1. Glazing

- overview of economics of extra glazing
- solar films - pros and cons
- considerations to replace glass with rework block or block up windows entirely
- shading

Section 2. Insulation/Infiltration

- overview of R values and the economics of increasing

Section 3. Infiltration

- in tall buildings (greater than 10 stories)
- in low buildings
- caulking
- building envelope openings, such as:

  (i) air opening
  ii) mechanical and elevator equipment room openings
  (iii) grade level doors
  (iv) vestibules
  (v) vapour barriers - where and when

Section 4. Maintenance for energy management.

Section 5. Thermography. Explanation of interpretation of results.

LEVEL II MODULE

Section 1. Glazing

- calculations to determine simple pay back period for glazing changes (graphically)
- when to remove windows/blockup
- solar films - pros and cons
- condensation considerations (graphically)
- shading

Section 2. Insulation

- calculation of optimum RSI value (graphically)
- insulation types and specific uses

Section 3. Infiltration/Exfiltration

- in tall buildings (over 10 stories)
- in low buildings
- to pressurize or not to pressurize
- volume of air required to pressurize and its energy costs
- significance of openings in upper half of building -mechanical and elevator rooms, fresh air dampers, exhaust systems, etc.
- energy management strategies
  - (i) caulking
  - (ii) vestibules
  - (iii) revolving doors
  - (iv) others
- how to calculate how much energy infiltration is costing
- vapour barriers, where and when

Section 4. Maintenance for energy management.

Section 5. Thermography. Explanation of interpretation of results.

SUBJECT 25. WASTE HEAT RECOVERY

DELIVERY TIMES
Introduction - up to 15 mins.
Level I - up to 25 mins.
Level II - up to 45 mins.

INTRODUCTORY MODULE

Section 1. Overview of available heat sources.

- boiler flue gas
- building exhaust
- process exhaust
  - (i) laundries
  - (ii) steam pipe tunnels
- flash steam
- waste warm or hot water
- diesel cooling system
- refrigeration equipment
- others

Section 2. Use of heat pumps.

LEVEL I MODULE

Section 1. Overview of available heat sources.

- boiler flue gas
- building exhaust
- process exhaust
  - (i) laundries
  - (ii) steam pipe tunnels
- flash steam
- waste warm or hot water
- diesel cooling system
- refrigeration equipment
- others

Section 2. Types of heat reclaim equipment with a limited explanation of their different operational theories, limitations and the economic opportunities for energy management for each type.

- heat wheels
- plate heat exchangers
- heat pipes

- run around coils
- shell and tube exchangers
- others

Section 3. Heat Pumps

- short discussion on theory of heat pumping

Section 4. Solar Collectors

- an overview

LEVEL II MODULE

Section 1. Overview of areas from where heat may be recovered.

- boiler flue gas
- building air exhaust
- process exhaust
  - (i) laundries
  - (ii) special equipment areas
- flash steam
- waste warm or hot water
- diesel cooling system
- water cooled refrigeration equipment
- others

Section 2. Types of heat reclaim equipment with an explanation of the different operational theories and the economic opportunities for energy management for each type.

- heat wheels
- plate heat exchangers
- heat pipes
- run around coils
- shell and tube exchangers
- others

Section 3. Heat Pumps

- heat pump theory and an analysis of how a building operator can evaluate whether or not a heat pump should be considered

Section 4. Solar Collectors

- a short discussion on the theory, difficulties and possible viability of solar heat collection

SUBJECT 26. SPECIAL SYSTEMS

DELIVERY TIMES
Introduction - up to 5 mins.
Level I - up to 30 mins.
Level II - up to 1 hour

INTRODUCTORY MODULE

Section 1. Energy management strategies for special systems.

LEVEL I MODULE

Section 1. Energy management strategies for special systems.

Kitchens	- turn off when food is not being prepared - ranges, ventilation
Laundries	- turn it off when laundry is not being processed - driers, ventilation
Swimming Pools	- cut back on ventilation during non-use hours if possible - pool covers
Laboratories	- turn off fume hoods where possible
Domestic Hot Water	- keep water as cool as possible - shower restrictors
Snow Melting	- remove snow, do not melt it wherever possible
Automobile Block Heaters	- timers and thermostats
Garages	- ventilation, use only when necessary - codes and standards
Locker Rooms	- ventilate to codes

The above are examples and not an exclusive list of energy management opportunities.

LEVEL II MODULE

Section 1. Energy management strategies for special systems.

Kitchens	- analyze the cooking methods for less energy per meal - minimize ventilation running times - determine how much ventilation is required - maintenance for energy management - codes and standards
Laundries	- turn it off when laundry not being processed - driers - shut off at night - ventilation
Swimming Pools	- water temperature - as low as possible within authorization - pool covers - make up water pre-heating, solar, waste heat reclaim - pool dehumidifing discussion (i) ventilate to dehumidify (ii) refrigerate to dehumidify - codes and standards - maintenance for energy management - heat pumping possibilities
Domestic Hot Water	- water temperatures - separate hot water generation for local uses - shower restrictors - turn off circulator during quiet hours - economics of domestic water piping insulation - maintenance for energy management
Snow Melting	- remove snow, melt only as last resort - demand control
Automobile Block Heaters	- timers - heat for shift changes - thermostats - no heat over -5°C. - demand control
Garage Ventilation	- understanding of codes and standards - timers - economic analysis of CO monitoring
Locker Room Ventilation	- understanding of codes and standards

The above are examples and not an exclusive list of energy management opportunities.

SUBJECT 27. DIESEL GENERATORS

DELIVERY TIMES
Introduction - up to 10 mins.
Level I - up to 10 mins.
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Possibility of reclaiming heat from diesel coolant for use in heating systems, domestic hot water, etc.

LEVEL I MODULE

Section 1. Possibility of reclaiming heat from diesel coolant for use in heating systems, domestic hot water, etc.

LEVEL II MODULE

Section 1. Possibility of reclaiming heat from diesel coolant and exhaust gases for use in heating systems, domestic hot water, etc.

Section 2. Necessary considerations.

- can heat be easily reclaimed without major diesel engine changes
- can heat be used to supplement other forms of energy
- possible use of flue gas heat to supplement other forms of energy
- using diesel generator for electrical demand peak shaving. Discuss regional demand penalty considerations
- codes and regulations regarding the use of emergency generators for other than dedicated emergency use

SUBJECT 28. STEAM TURBINES

DELIVERY TIMES
Introduction - up to 5 mins.
Level II - up to 30 mins.

INTRODUCTORY MODULE

Section 1. Steam turbines as a type of specialized steam plant equipment that should be removed.

LEVEL II MODULE

Section 1. Operational theory.

Section 2. Control.

Section 3. Performance under varying steam pressures.

Section 4. Use of turbines as drivers using waste heat energy.

Section 5. Economics of steam turbines versus electric drivers.

Section 6. Other energy management strategies.

SUBJECT 29. VERTICAL TRANSPORTATION

DELIVERY TIMES
Introduction - up to 5 mins.
Level II - up to 20 mins.

INTRODUCTORY MODULE

Section 1. Discussion on energy management strategies on elevators and escalators.

LEVEL II MODULE

Section 2. Discussion on energy management strategies on elevators and escalators.

FUNDAMENTALS

Appendix 1

A fan is a gas flow producing machine which operates on the same basic principles as a centrifugal pump or compressor. Each of these devices, including the fan, convert rotational mechanical energy, applied to their shafts, to total pressure increase of the moving gas. This conversion is accomplished by changing the momentum of the fluid.

The apparent difference between fans and pumps is pumps usually handle liquid. The distinction between fans and compressors is not so obvious. The American Society of Mechanical Engineers' power test codes limit the fan definition to machines which increase the density of the gas by no more that 7% as it travels from inlet to outlet. This is a rise of about 76 cm. of water pressure based on standard air.

Fans for heating, ventilating and air conditioning, even on high velocity, high pressure systems, rarely encounter more than 25.4 - 30.4 cm. of water pressure.

Terminology, Abbreviations and Definitions

Definitions of terms common in fan technology follow. Any meaningful discussion of a technical subject can only be carried on if a clear understanding of terminology is reached.

Standard Air - Air at a temperature of 16.67°C dry bulb and a barometric pressure of 101.35 kPa of mercury with a density of 1.2 kg/m^3.

Water Gauge (Figure 1) - The measure of pressure above atmospheric expressed as the height of a column of water in inches (atmospheric at sea level equals 101.35 kPa.

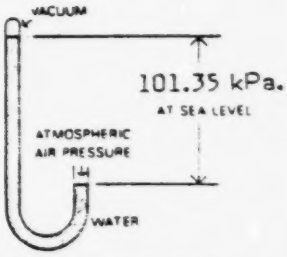

Figure 1—Atmospheric Pressure

L/S and SL/S = the litres per second L/S of air produced by a fan in a given system is independent of the air density.

L/S Litres per second of air handled by a fan at any air density

SL/S Litres per second of standard air (1.2kg/m^3) handled by a fan

Fan Total Pressure (TP) - Fan total pressure is the difference between the total pressure at the fan outlet and the total pressure at the fan inlet. The fan total pressure is the measure of the total mechanical energy added to the air or gas by the fan. How this is measured is illustrated in Figure 2.

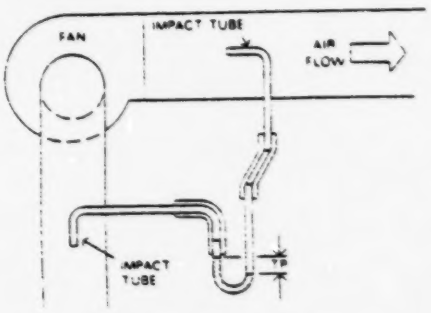

Figure 2—Fan Total Pressure